

Experiments to ascertain the Correction for Variations of Temperature, within the limits of the natural Temperature of the Climate of the South of England, of the Invariable Pendulum recently employed by British Observers. By Captain Edward Sabine, of the Royal Artillery, Sec. R.S. Read March 25, 1830. [Phil. Trans. 1830, p. 251.]

The correction for temperature which the author deduces as the general result of his investigation, is 0.44 of a vibration *per diem* for each degree of Fahrenheit between 30° and 60°. He considers this result as entitled to the greater confidence, from the favourable nature of the circumstances under which the inquiry was conducted; since the influence of natural temperature is more permanent and equable than that of temperatures artificially produced. He considers it as desirable, however, that means should be devised of extending experiments on this subject to a wider range of temperatures.

On a new Register-Pyrometer, for measuring the Expansions of Solids, and determining the higher Degrees of Temperature upon the common thermometric Scale. By J. Frederic Daniell, Esq. F.R.S. Read June 17, 1830. [Phil. Trans. 1830, p. 257.]

In the year 1821, the author published in the Journal of the Royal Institution an account of a new pyrometer, and of some determinations of high temperatures, in connexion with the scale of the mercurial thermometer, obtained by its means. The use of the instrument then described was, however, limited; and the author was subsequently led to the invention of a pyrometer of a more universal application, both to scientific researches and to various purposes of art. He introduces the subject by an account of the late attempt of M. Guyton de Morveau, to employ the expansions of platina for the admeasurement of high temperatures, and for connecting the indications of Wedgwood's pyrometer with the mercurial scale, and verifying its regularity. The experiments of that philosopher were by the contraction of porcelain, and by actual comparison with those of the platina pyrometer, at no higher temperature than the melting point of antimony; but they are sufficient to establish the existence of a great error in Wedgwood's original estimation of his degrees up to that point. This he carries on by calculation, on the hypothesis of uniform progression of expansion, up to the melting point of iron; the construction of his instrument not admitting of its application to higher temperatures than a red heat, in which platina becomes soft and ductile. Mr. Daniell shows, by an examination of M. Guyton's results, that he has failed in establishing the point he laboured to prove; namely, the regularity of the contraction of the clay pieces.

The pyrometer of the author consists of two distinct parts; the one designated the *register*, the other the *scale*.

The first is a square tube of black-lead, 8 inches long, cut out of a common crucible of that material, closed at one end, and having at the other a portion of about six tenths of an inch in length cut away

to the depth of half the diameter of the bore, so as to leave a shoulder near the end. A bar of any metal $6\frac{1}{2}$ inches long is introduced into the cavity, resting against its solid end, and a cylindrical piece of porcelain, about $1\frac{1}{2}$ inch long, which he calls the index, is placed upon the top of the bar, and projects beyond the open part of the tube, being confined in its place by a ring or strap of platina passing round it, and also round the end of the black-lead bar, and made sufficiently tight by a small porcelain wedge inserted between them. When the instrument thus prepared is subjected to heat, the porcelain index will be forced up, by the expansion of the metallic bar, to a certain distance, where it will remain when the bar retires from it on cooling. The distance it has been moved from its original position, will be the measure of the difference of expansion of the metallic bar, and of an equal length of the black-lead in which it is contained. This cannot be influenced by any permanent contraction which the black-lead may undergo by intense heat, because any such contraction will occur at the moment of the greatest expansion of the metal, and the index will still mark its point of furthest extension upon this contracted basis. It remains then to measure accurately the distance to which the index has been moved by the application of the scale, which is a detached instrument constructed of two rules of brass joined together at a right angle; the one fitting square upon two sides of the black-lead bar, the other resting on its shoulder; with these are connected two arms, which, acting on the principle of proportional compasses, measure the distance of the extremity of the index from the shoulder of the black-lead bar. The spaces comprehended between the points of the shorter legs of the compasses are magnified ten times by the longer legs, the angular motion being measured by a graduated arc furnished with a vernier, and capable of being easily read off to minutes.

The author next enters into a comparison of the results afforded by this instrument with those of former experimentalists; and especially with the accurate determination of the expansions of metals by Messrs. Dulong and Petit, with a view to show the degree of confidence to which it is entitled. The close agreement in the results of a great number of experiments upon metals which differ much in their expansions is highly satisfactory in this respect. Differences having been found in the expansibility of different specimens of black-lead, it becomes necessary to ascertain the expansions of each register for itself, by applying to it the heat of boiling mercury. The author concludes with an account of some experiments which he made to determine the fusing points of different metals, referred to the common thermometric scale. His calculations proceed upon the supposition that the equal amounts of expansion denote equal increments of temperature; and he is thus enabled to compare the series now obtained with that which was obtained with his first pyrometer. A remarkable accordance is found between the results with platina and with iron,—metals which differ widely in their expansions; conformably with the conclusions of MM. Dulong and Petit, the expansion

of iron increases at higher temperatures in a greater ratio than that of platina. The discrepancy between the temperatures derived from the observations with his first pyrometer and the present one, he admits to be considerable, but believes they may be sufficiently accounted for by the differences in the circumstances of the experiments, without imputing inaccuracy to the instrument. The author next attempted to ascertain the effects of the most intense heat which it was possible to produce in a furnace, and to measure the utmost limits of expansion in a platina bar; but various circumstances interfered with the success of these experiments, which afforded, however, many curious results as to changes of integration in platina by the effects of heat.—The paper concludes with some observations on the practical advantages possessed by the present instrument.

On the Phenomena and Laws of Elliptic Polarization, as exhibited in the Action of Metals upon Light. By David Brewster, LL.D. F.R.S. L. & E. Read April 22, 1830. [*Phil. Trans.* 1830, p. 287.]

The action of metals upon light has always presented a remarkable, and hitherto inexplicable, anomaly in the science of polarization. Malus, to whom this branch of optics owes its origin, had at first announced that metals exerted no polarizing influence on light; but Dr. Brewster, by employing a different method of observation, ascertained that the light reflected from metallic surfaces was modified in such a manner as to exhibit, when transmitted through thin crystallized plates, the complementary colours of polarized light. He afterwards discovered the curious property possessed by silver and gold, of dividing a polarized ray into complementary colours by successive reflexions. M. Biot, to whom the author communicated this discovery, pursued the inquiry to which it led, and arrived at the same conclusions as to the mode in which this class of phenomena should be explained. Subsequent researches, however, convinced the author that these generalizations had been too hastily formed; and the study of Fresnel's curious discoveries respecting circular polarization enabled him to advance still further in the inquiry, and he now presents to the Royal Society in this paper, a complete analysis of the singular phenomena exhibited in the action of metals upon light.

The first section of the paper treats of the action of metals upon common light. A ray of common light reflected from a metallic surface when analysed by a rhomb of calcareous spar, exhibits a defalcation of light in one of the images, as if a portion of the light was polarized in the plane of reflexion. This effect will be still more distinctly seen on examining the system of polarized rings formed round the axes of crystals by means of the light reflected from metals. If the light had suffered no modification by reflexion, or if the metal reflected in equal quantities the light polarized in opposite planes, the rings would not be visible at all, whereas it is found that they are easily visible in the light reflected from all metals. They are most distinctly perceived at an incidence of about 74° , and be-